

The workplace: indoor environmental conditions and productivity

By Tom Cudmore 31st July 2017

Workplace and productivity have become major themes in FM over recent months. Here, Tom Cudmore looks at the crucial role of the environment, its impact on people and how all that can be measured.



[A previous article](#) introduced the Whole Life Performance Plus project (WLP+), a real-world research trial supported by Innovate UK and EPSRC, to improve workplace productivity by 10% by optimising indoor environmental quality (IEQ).

Building performance specialist LCMB is the industry lead on the project, while the Low Carbon Building Group at Oxford Brookes University is the academic lead. They are working with a consortium of Argent, King's College London, EMCOR UK, the British Council for Offices and Constructing Excellence. A fundamental challenge this group has had to overcome is how best to collect quality data on indoor environmental conditions and measure productivity.

In light of [continued reduction in UK productivity](#), as reported earlier this month by the Office for National Statistics, this is a topical issue. For the first three months of 2017, there has been a fall in hourly output of 0.5%, which is accompanied with persistent UK underperformance of over 30% compared to major trading partners, including the US, France and Germany. This means that there is a real and very large opportunity to improve the UK's competitiveness on the world stage as it implements BREXIT. This can be done by focusing on systematically raising productivity levels to the levels of other European nations. Business leaders agree there is no single issue responsible, but potential exists to unlock £100bn of additional output from the UK economy if small, medium and large businesses in all sectors can make modest improvements in output. LCMB believes optimising the IEQ of workplaces can help plug some of this productivity gap for UK PLC.

Measuring indoor environmental quality

Research into IEQ and productivity has typically focused on the impact of temperature, relative humidity and CO2 concentration, and shows productivity improvements of 5 - 10% when conditions are optimised. Temperatures below 20oC and above 24oC have been proven to impact negatively on performance, and research shows as CO2 concentration rises there is greater deterioration in cognitive ability.

To understand the impact on productivity you first need to decide what IEQ variables to measure and how you will get reliable data for these variables. Early findings from the WLP+ project suggest air quality and workplace temperature to be the most important variables, but available technology can incorporate a wide range of additional measures such as relative humidity, noise, light levels and motion detection.

Monitoring equipment and Internet of Things (IOT) technology is in a period of rapid growth, and there are many solutions already available, with new ones appearing all the time. Devices broadly fit into three categories:

- Data loggers
- Monitoring additions to existing control systems such as building management systems
- IOT solutions for monitoring.

The best option will depend on how you intend to use the data. There are many considerations including cost, ease of deployment, need for remote data, sample intervals, availability of power supplies, accuracy, reliability, need for sensors to be tamper-proof, the metrics you want to measure and so on.

In our experience, the biggest challenges are the practical ones. First, clients allowing devices to connect on their intranet, communication of gateways with cloud servers, and getting buy-in from the various stakeholders who occupy the buildings. Second, validating the results, managing and mining the data, and a risk of drawing the wrong conclusions based on misleading data.

Measuring productivity

The first question most people ask about the WLP+ study is ‘how are you measuring productivity?’ It’s a fair question, as there is no universally agreed definition that can be applied to all organisations. In the research context the measure also needs to be statistically valid and reliable. For example, a 2015 Harvard study looking at IEQ associations with cognitive function scores, used simulated office space in a climate chamber to conduct a closely controlled experiment with productivity measured using a strategic management simulation software tool, which is a computer-based test. This was possible due to the lab-based design and low subject numbers. However, in real-world research such as WLP+, methods must also consider issues such as participant survey fatigue and disruption to normal working practices.

In the first phase of the WLP+ project, the Low Carbon Building Group at Oxford Brookes University conducted a review of existing productivity research and found that measures typically fall into one of four categories:

- Self-reported measures
- Assessed task performance
- Business output metrics (manufacturing output, cost of sales etc)
- HR metrics (sickness rates, staff turnover etc).

Self-reported measures provide an indirect assessment of productivity that is sometimes criticised as too subjective to be meaningful. However, previous research has shown considerable value from this approach, providing questions are well-designed and used consistently. A more objective approach is to use cognitive tests already established in academic studies as a proxy for productivity. For example, the Stroop Test asks participants to read the colour of words displayed in mixed colours and is widely used in experimental psychology. The exercise causes interference in the reaction time of the brain and response time is used to rate performance. In the WLP+ project, several cognitive tests are being used alongside self-reported measures as an agreed measure of productivity with our case study partners.

For an organisation wishing to conduct their own productivity research a self-reported questionnaire would be a sensible starting point. However, productivity will ultimately mean different things to different organisations, and data already collected is often under-utilised but can provide valuable insight. Sources such as customer feedback scores, helpdesk reports, bottom-line performance and staff absenteeism are good examples of this.

Settling on a chosen business measure, combining with self-reported productivity, and measures of the indoor environmental quality will allow your organisation to assess priorities for building investment and understand the impact of the environment on staff performance.

Progress so far

Monitoring the indoor environment and collecting feedback from staff should be a straightforward exercise; but as the UK-GBC Wellbeing Lab trial showed, it is quite a challenge to deliver successfully. The WLP+ project has provided a valuable insight as to how systems can

be efficiently deployed, and more importantly how results can be interpreted to optimise building conditions and improve business outcomes.

The good news is this project is delivering a methodology for measuring the existing performance of workplaces and the interventions required to optimise their IEQ to improve worker productivity, health and well-being.

Tom Cudmore is Senior Consultant at building performance specialists [LCMB](#). You can learn more about WLP+ [here](#).